Principles for Evaluating Effectiveness of Capping versus Dredging Remedies for Contaminated Sediment

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Sediment Remediation Alternatives

“A Fourth Environmental Medium”

- No Action
- Monitored Natural Recovery
- In-Situ Capping
- In-Situ Treatment
- Dredging with Containment
  - CDFs, CADs, or Licensed Landfills
- Dredging with Treatment and Disposal

NCP Screening Criteria

- **Threshold Criteria**
  - Overall Protection of HH and Environment
  - Compliance with ARARs
- **Balancing Criteria**
  - Implementability
  - Short Term Effectiveness
  - Long Term Effectiveness and Permanence
  - Reduction in Toxicity Mobility and Volume through Treatment
  - Cost
- **Modifying Criteria**
  - State Acceptance
  - Community Acceptance

Effectiveness – First things that come to mind

- Capping
  - Will it work?
  - Will it stay in place?
- Dredging
  - Can I get it all out?
  - Will I resuspend too much?

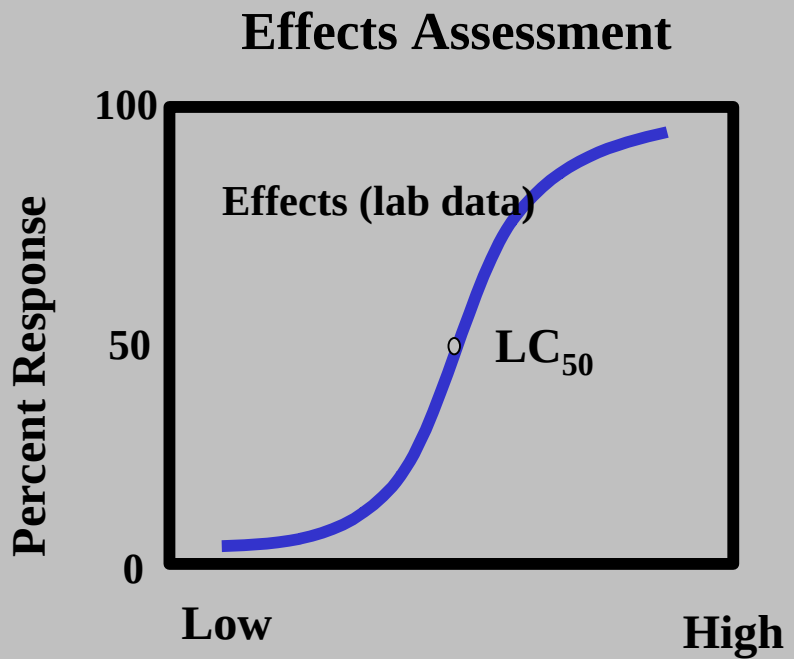
- **GOOD QUESTIONS, BUT THERE'S MORE TO IT.**

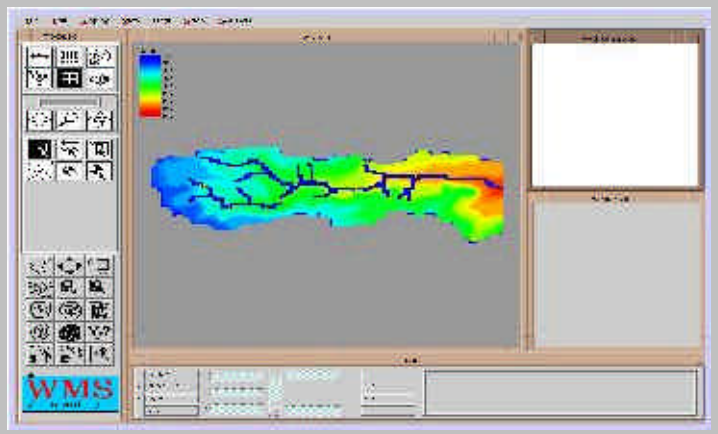
10 Principles for Effective Sediment Remedies

- All decisions should be risk-based
- Control sources
- Set realistic RAOs, RGs, and CULs
- Compare effectiveness of options on an equal footing
- Evaluate Spatial and Temporal aspects of exposure
- Tailor operations to achieve Short Term Effectiveness
- Design for Long Term Effectiveness and Permanence
- Develop site-specific, project-specific, and sediment specific remedies
- Optimize effectiveness by combining options
- Monitor to document effectiveness

All decisions should be risk-based

- Risk reduction is the overall objective
- Baseline risk assessment
- Incremental risk reduction
- Present risk and Future risk
- Comparative risk assessments for remedies





Control sources

- Sources should be fully characterized
- Source controls should be considered the first component of the remedy
- Source control component should be in place prior to other components

Set realistic RAOs, RGs, and CULs

- Remedial Action Objectives (RAOs)
  - Specific to receptors
  - Example RAO - Reduce cancer risk for fishers
- Remediation Goals (RGs)
  - Tied to receptors and pathways
  - Example RG – tissue level in benthic biota
- Cleanup levels (CULs)
  - Consider NCP Criteria
  - Example CUL – sediment concentration in biologically active zone

Compare effectiveness of options on an equal footing

- A definite challenge
- All components of the remedy must be considered
- Evaluate effectiveness and permanence over comparable time periods
- Comparative Risk Assessment for Remedy Options

Evaluate Spatial and Temporal aspects of exposure

- Most sites have aerial and vertical COC gradients
- Consider background and proximate area
- Surficial sediment layers present on-going risk
- Risk is proportional to area of surficial contamination
- Deeper buried sediments present potential future risk
- Not all contamination can or should be remediated
- Contamination gradients change over time
- Risk is proportional to the time of exposure
- Dredging or capping “restarts the clock”

Tailor operations to achieve Short Term Effectiveness

- Capping
  - Resuspension
  - Mixing
  - Consolidation
- Dredging/ Treatment/ Disposal
  - Resuspension
  - Residual
  - Disposal Releases/ emissions

- Accept short term sacrifices for long term gains
- Place in context with other on-going processes

Design for Long Term Effectiveness and Permanence

- **Capping**
  - Design to maintain CULs
  - Erosion
  - Seismic stability
  - Groundwater flow
  - Long term diffusion
- **Dredging and Disposal**
  - Target for mass removal or to achieve CULs
  - Disposal site releases and emissions
  - Permanence of controls
- **Design for episodic events appropriately**

Develop site-specific, project-specific, and sediment specific remedies

- Project Specific
  - regulatory framework, volume, area, thickness, etc.
- Site Specific
  - water depth, hydrodynamics, climate, infrastructure, proximate resources
- Sediment Specific
  - presence of debris, physical properties, COCs

Optimize effectiveness by combining options

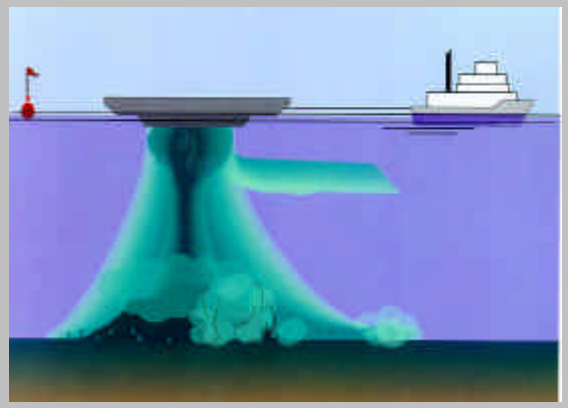
- Combinations often most acceptable to all parties
- Combinations provide a balance of effectiveness and costs
- Combinations help offset disadvantages of respective single options
- Examples
  - Monitored Natural Recovery (MNR) for larger adjacent areas
  - Dredging hotspots combined with capping adjacent areas
  - Dredging followed by thin capping of residuals

Monitor to document success

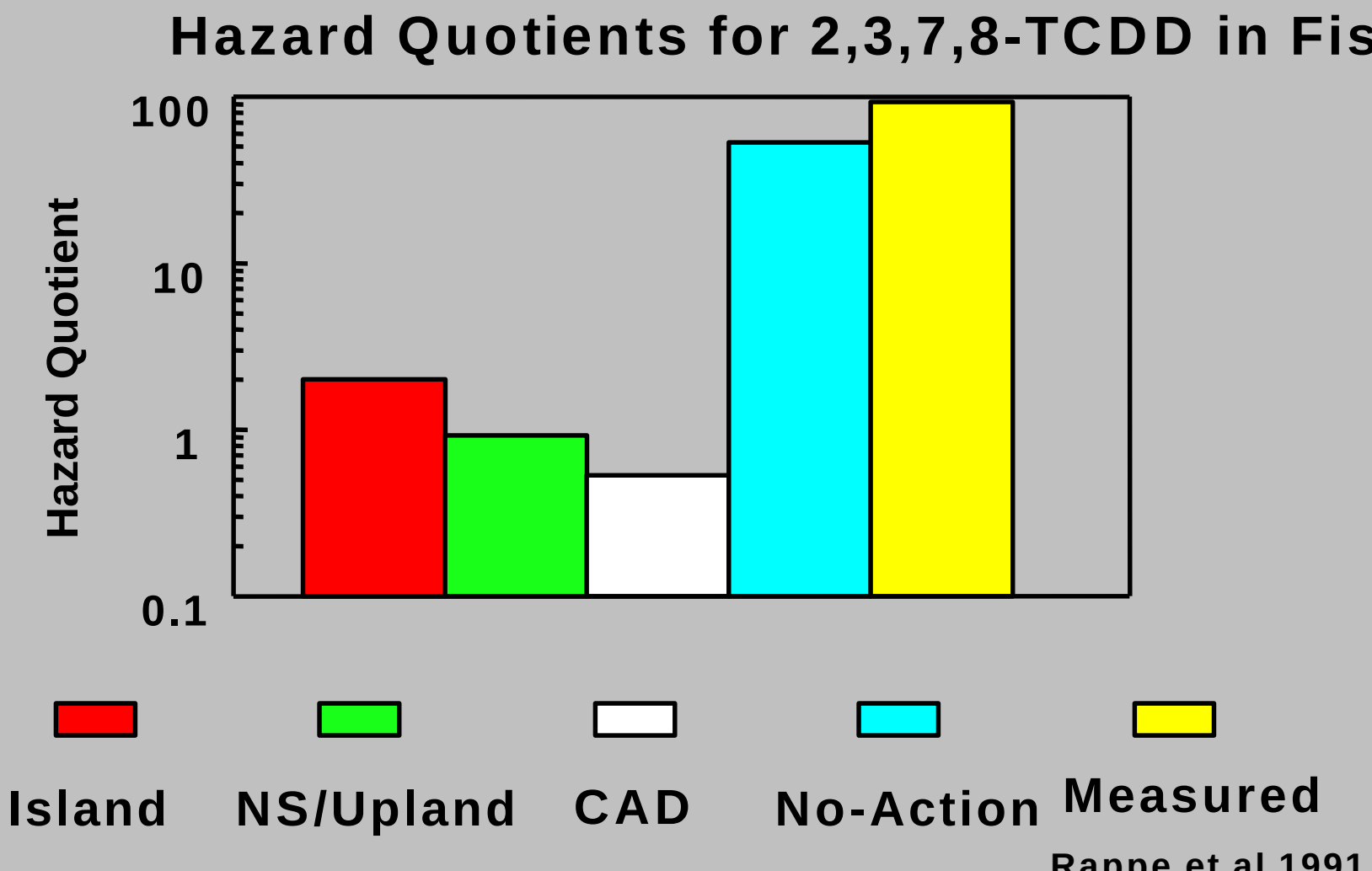
- Historically, few sediment remedies have been adequately monitored
- Capping
  - Fewer capping remedies selected
  - Long time periods required to confirm effectiveness
- Dredging
  - On the order of 30 well documented projects
  - Effectiveness of the removal easy to document
  - Long time periods required to confirm disposal site effectiveness
- Deliberate effort is needed to build a base of field experiences

Tools for Evaluating Effectiveness

- Effects-based testing
- Models
- Effects Databases
- Design Guidance
- Comparative Risk Assessments
- Field Monitoring



Case Study: NY/NJ Harbor



Rappe et al 1991

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